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Atty. Docket No. 004070 USA/PDC/WF/OR

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of

Haim FELDMAN

Application No.: 09/855,253 Group Art Unit: 2878

Confirmation No.: 8980 Examiner: Tranh X. Luu

Filed: May 15, 2001

For: DYNAMIC AUTOMATIC FOCUSING METHOD AND APPARATUS USING INTERFERENCE PATTERNS (As Amended)

SUBMISSION OF APPELLANT'S BRIEF ON APPEAL

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Further to the Notice of Appeal filed September 8, 2003, submitted herewith please find an original and two copies of Appellant's Brief on Appeal. A check for the statutory fee of $330.00 is attached. Authorization is also given to charge or credit any difference or overpayment to Deposit Account No. 19-4880. A duplicate copy of this paper is attached.

Respectfully submitted,

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Date: January 20, 2004

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Date: January 20, 2004

Signed: Thea K. Wagner

Thea K. Wagner

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APPELLANT'S BRIEF ON APPEAL UNDER 37 C.F.R. § 1.192

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Appellant, within a two (2) month period from the September 8, 2003, filing date of the Notice of Appeal (November 8 having fallen on a Saturday, and November 10 being the first business day thereafter), herein files an Appeal Brief drafted in accordance with the provisions of 37 C.F.R. § 1.192, as follows:

I. REAL PARTY IN INTEREST

The real party in interest is the owner of the application, APPLIED MATERIALS, INC.

II. RELATED APPEALS AND INTERFERENCES

Appellant is not aware of any other appeals or interferences involving the present application.

III. STATUS OF CLAIMS

Claims 1-19 are all the claims pending in the application. Claims 1, 12-16, and 18 are rejected under 35 U.S.C. § 102(b) as being anticipated by Maeda et al., USP 5,572,323 ("Maeda"). Claim 11 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Maeda. Claims 2-10, 17, and 19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all the limitations of the base claim and any intervening claims.

IV. STATUS OF AMENDMENTS

The claims have not been amended pursuant to final rejection.

V. SUMMARY OF THE INVENTION

As described in the present application, the present invention relates to detection of a position of a plane defined by an article being processed, relative to the focal plane of an optical system, thereby enabling maintenance of accurate focusing of an incident beam from the optical system to the article. According to the present invention, at least two interference patterns formed by light components returned from an elongated illuminated region on the article and passing through at least two symmetrical peripheral regions of the optical axis of a focusing/collecting lens arrangement are detected.

As claimed in the present application, each of these interference patterns is created by interference between collected light formed of light components propagating within one of the periphery regions and collected light formed of light components propagating within the paraxial

regions of the optical axis. The relation between the interference patterns is indicative of the phase difference between the collected light formed of light components propagating within the paraxial and periphery regions, and consequently, of the out-of-focus position of the illuminated region.

Light waves returned from an in-focus plane and passed through a focusing lens will have a substantially flat wavefront. Light waves returned from an out-of-focus plane and passed through a focusing lens will have a substantially spherical wavefronts. As a result, information indicative of distortions produced at any out-of-focus location is actually contained in light propagating within a periphery region of the optical axis, rather than that associated with a paraxial area.

Therefore, it is desirable to analyze light components propagating within the periphery regions, in order to detect a focus error. It is necessary to take into account that light components propagating within the paraxial and periphery regions of the optical axis have different optical paths, respectively, and therefore have a certain phase difference indicative of the out-of-focus position of the article.

As described beginning at page 12 of the application, Fig. 1 shows an optical inspection system 1 which includes a scanning apparatus 1a. As shown in more detail in Fig. 2, and as described beginning at page 15 of the application, the scanning apparatus 1a includes a focus detection unit 8 which includes in turn an optical system 9. The optical system 9 forms images indicative of the position of the surface 2a (Fig. 1) of an article 2 being inspected, relative to the focal plane P on sensing surface 21.

The optical system 9 comprises lens arrangements 30, 32 and 34 and a blocking plate 35 interposed between the lens arrangements 30 and 32. The lens arrangements define a common optical axis OA_2 of light propagation through the optical system 9. The plate 35 is oriented perpendicularly to the optical axis OA_2, i.e., in the X-Y plane.

In the embodiment shown in Fig. 2, the plate 35 is formed with slits 35a, 35b and 35c aligned in a spaced-apart parallel relationship along the Y-axis, the slits 35a and 35b also being spaced with respect to each other along the X-axis. The three slits represent three transmitting regions, respectively, surrounded by blocking regions of the plate 35, thereby picking up three light components from light impinging onto the plate 35 and transmitting them towards the lens arrangement 32. The central slit 35b may extend substantially across the entire plate 35. In the described embodiment, the upper and lower slits 35a and 35c are located centrally symmetrically relative to an intersection point IP_1 between the plate 35 and the optical axis OA_2.

The slits are arranged to transmit light from three transmitting regions from the paraxial and periphery regions of the optical axis. The central slit may extend substantially across the blocking plate, and the other two slits are located centrally symmetrically relative to the central slit.

The slit arrangement described in the present application produces two separate interference patterns. A first interference pattern is produced between one of the two slits and a corresponding half of the central slit. A second interference pattern is produced between the other of the two slits and the corresponding half of the central slit. The interference patterns produced by the three slits are shown in Figs. 4, 5a, and 6a, illustrating in-focus and out-of-focus conditions.

Figs. 3a and 3b in the present application, described beginning at the bottom of page 17 of the specification, illustrate principles of light propagation from in-focus and out-of-focus positions, underlying the above design of the optical system 9. Fig. 3a illustrates a wave front W_1 of returned light 28 (Figs. 1 and 2) corresponding to an in-focus location of an illuminated line S in Fig. 1. As noted earlier, because wave front W_1 corresponds to an in-focus condition, that wave front typically will be substantially flat.

Fig. 3b illustrates a wave front W_2 of the returned light 28 corresponding to an out-of-focus location of the illuminated line S. As also noted earlier, the out-of-focus location is characterized by a substantially spherical wave front W_2. The returned light 28 propagates within regions R_1 and R_2 in Fig. 3b, lying substantially far from and close to the optical axis OA_1, respectively, i.e., periphery and paraxial regions, respectively, with respect to the optical axis OA_1. Significant curvatures of the wave front W_2 are located within the periphery regions R_1; on the other hand, such curvatures are relatively negligible within the paraxial regions R_2.

The periphery regions of the lens are more sensitive to an out-of-focus position of the light source. As a result, detected light formed by light components propagating within the periphery regions R_1 will contain the main information indicative of the out-of-focus location of the line S.

Thus, as described in the Abstract, the first interference pattern is created by interference of light components of the collected light that propagated within a first periphery region of an optical axis of the focusing optics and light components of the collected light that propagated within a paraxial region of the optical axis. The second interference pattern is created by interference

between light components of the collected light that propagated with a second periphery region of the optical axis, symmetrical to the first periphery region with respect to the optical axis, and light components of the collected light that propagated within the paraxial region.

From the foregoing description, and the discussion of periphery and paraxial regions of the optical axis as discussed in the present application, the interference patterns that the invention produces are separate and distinct, and not merely two halves of the same interference pattern. This distinction is critical to an understanding of the differences between the claimed invention and Maeda, as now will be discussed.

VI. ISSUES

1. Does the prior art teach or reasonably suggest a focus error correction method and apparatus wherein at least two interference patterns are created, a first interference pattern created by interference between light components of a first periphery region and a paraxial region of an optical axis, and a second interference pattern created by interference between light components of a second periphery region and the paraxial region of the optical axis a as recited in claims 1, 15-16, and 18?

2. Does the prior art teach or reasonably suggest a focus error correction method and apparatus having a display for displaying the first and second images, as recited in claim 11?

3. Does the prior art teach or reasonably suggest a processor for receiving data representative of at least two images of interference patterns and for generating output

signals indicative of the position of the article relative to the focal plane as recited in claims 12-14?

VII. GROUPING OF CLAIMS

Claims 1, 15-16, and 18 stand and fall together. Claim 11 stands or falls on its own. Claims 12 -14 stand and fall together.

VIII. ARGUMENTS

Issue 1: Does the prior art teach or reasonably suggest a focus error correction method and apparatus wherein at least two interference patterns are created, a first interference pattern created by interference between light components of a first periphery region and a paraxial region of an optical axis, and a second interference pattern created by interference between light components of a second periphery and the paraxial region of the optical axis a as recited in claims 1, 15, 16, and 18?

Claims 1, 15-16, and 18 recite creating at least two interference patterns, wherein a first interference pattern is created by interference between light collected from within a first periphery region and from within a paraxial region of an optical axis, and wherein a second interference pattern is created by interference between light collected from within a second periphery region and from within a paraxial region of the optical axis. The claims further recite the structures required to provide the light necessary to form the at least two interference patterns. Maeda does not anticipate, teach, or suggest an apparatus or method for providing at least two interference patterns between at least two periphery regions of an optical axis and a paraxial region of the optical axis. To the contrary, Maeda describes a focusing apparatus that relies upon a single interference pattern generated by a first and a second diffraction grating.

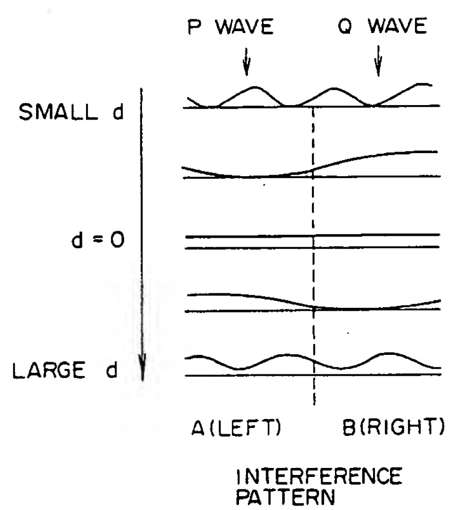
Also, Maeda does not anticipate, teach, or suggest forming interference patterns from different regions of a beam of light.

Maeda takes two peripheral rays and subjects them each to double diffraction gratings, thus producing multiple diffraction orders because of each of the rays. One diffraction order from one of the initial rays is interfered with the inverse diffraction order from the other ray. The resulting interference produces a single set of fringes, with a pitch corresponding to the amount of the out-of-focus condition. The measurement then depends on measuring the pitch of the final interference pattern, which is a single pattern. There is no use of a central ray as described and claimed in the present application.

In contrast, according to the present invention, two peripheral rays each are interfered with a central ray, thus producing two interference patterns (two sets of fringes, not just one, as in Maeda). The fringes are of fixed pitch, not variable as in Maeda (where the variability corresponds to the defocus condition). Rather, in the invention, the degree of defocus depends on the relative offset between the multiple fringes. Thus, to determine the degree of defocus in the invention, it is necessary to measure the amount of that offset. This is the claimed relation between intensity profiles in the at least two interference patterns, that relation being indicative of the position of the article relative to a focal plane of the focusing optics. This language is found in all of the independent claims, and clearly distinguishes over Maeda.

The Examiner directs Appellant's attention to Maeda, Figs. 11a-b-c and 12 wherein Fig. 12 purportedly shows two interference patterns, one on the left of the figure and the other on the right of the figure. Maeda Fig. 12 is reproduced below:

FIG . 12



Maeda describes Fig. 12 by stating, "Qualitatively, light intensity distribution of **the interference pattern** is varied in accordance with the states of the defocusing, as shown in FIG. 12. In FIG. 12, the light intensity distributions of **the interference pattern** in cases where the defocusing d is negative (d) and positive (d) are inverted to each other." *See*, col. 10, lines 29-33 (*emphasis added*). Maeda itself refers to Fig. 12 as showing only a single interference pattern. The dashed line merely differentiates between the P and Q waveforms in that single interference pattern.

By Maeda's own description, Fig. 12 does not show, nor did Maeda intend to show, more than a single interference pattern. The Examiner' inference of multiple interference patterns

from Maeda is a distortion of the fair teaching of Maeda, and represents the sheerest form of hindsight reconstruction.

The P and Q waves shown in Maeda Figs. 11 a-b-c are plus or minus first order diffraction lights used to measure the defocusing of the illuminating laser beam. The P and Q waves are formed by two diffraction gratings each having the same period, but the phase difference between the first and the second grating is one-quarter wave length. The P and Q waves propagate parallel to each other in an interleaved pattern, and when defocusing occurs, each of the P and Q waves are microscopically deformed such that the normally parallel wave fronts intersect thereby causing an interference pattern as shown in Fig. 2. *See*, col. 10, lines 1-28.

An interference pattern is formed when two waves intersect. Maeda describes forming two waves, the P and Q waves, using two diffraction gratings. The intersection of these waves contains information regarding the focusing condition. The two intersecting waves can form only a single interference pattern. Therefore, Maeda can only be describing a single interference pattern. In contrast, the present application claims <u>at least two interference patterns</u>.

Not only is the Examiner's interpretation of Maeda inconsistent with Maeda's fair teaching; Appellant's interpretation of Fig. 12 is consistent with Maeda's specification and claims. Throughout the specification and claims, Maeda refers only to a single interference pattern as indicated by the use of the article "the" to modify "interference pattern." Nowhere in the specification or claims does Maeda refer to more than one interference pattern, directly or indirectly. In the brief description of the drawings, at col. 4, lines 20-21, Maeda says that Fig. 12

"is a diagram illustrating the light intensity distribution of interference patterns". This passage does not state that Maeda teaches multiple interference patterns. Indeed, as can be seen from the quotes from Maeda actually describing Fig. 12, there is but a single interference pattern intended and described. As discussed above, Fig. 12 shows an interference pattern in various conditions of defocus, and Maeda is referring to the light intensity distribution of the different states of defocus.

The Examiner has stated that an interference pattern "divided in half produces two interference patterns." *See* OAS dated 5/7/2003, p. 5, para. 8. Appellant contends that dividing a single interference pattern yields only copies of the single interference pattern. Dividing a single interference pattern does not produce multiple interference patterns, as described and claimed in the present application.

As Appellant argued above, an interference pattern is generated by the intersection of two light waves. The present application describes at least two such intersections: light from a first periphery region and from the paraxial region; and light from a second periphery region and the paraxial region. These two intersections form two distinct interference patterns, not two copies of a single interference pattern. Therefore, even if Maeda's Fig. 12 were to show a divided interference pattern – which Appellant contends it does not – that Figure cannot anticipate or render obvious the claimed two interference patterns.

Additionally, claims 1, 15-16, and 18 recite that interference patterns are formed from at least two periphery regions of an optical axis and a paraxial region of the optical axis. In contrast, Maeda provides a single interference pattern of the entire reflected beam as shown in

Fig. 2. "A reflected laser beam from the article 13 travels through the objective lens 12 again and passes through the beam splitter 11. The laser beam from the beam splitter 11 is incident on a double grating unit 14 having a function for generating interference fringes." *See*, col. 5, lines 1-5. Maeda does not teach or suggest that the single interference pattern is formed by the intersection of light from one region of the reflected beam with the light from another region, but instead, the entire reflected beam impinges upon the diffraction gratings to form the single interference pattern.

Therefore, Appellant contends that there is no motivation in the prior art to provide the configurations set forth in claims 1, 15-16, and 18. Appellant submits that these claims are patentable.

Issue 2: Does the prior art teach or reasonably suggest a focus error correction method and apparatus having a display for displaying the first and second images, as recited in claim 11?

In rejecting claim 11 in view of Maeda, the Examiner took the position that it would have been obvious to a person of ordinary skill in the art to provide a display for displaying the claimed images, even though Maeda discloses no such display. Looking more closely at claim 11, the claim recites a display for monitoring the first and second interference pattern images.

In addition to there being no teaching or suggestion in Maeda that more than one interference pattern is generated, there is no teaching or suggestion that such interference patterns should be displayed. In Figs. 17A-B, Maeda shows an infinitesimal displacement system that relies upon the detection of individual fringes of the interference pattern to provide control signals for adjusting the focus. Interference fringes are present when the system is not in

focus. Maeda uses photo-detectors having two detection areas to detect an out-of-focus condition by the presence or absence of fringes, and to provide a driving signal to move the objective lens. *See*, col. 16 line 50 to col. 17, line 16. There is nothing about displaying interference pattern images.

Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. *See* MPEP 2143.01. Maeda provides no motivation to combine a display for monitoring interference patterns with the teachings of Maeda because Maeda's detecting circuitry detects the presence or absence of fringes only. There is no motivation to view the entire interference pattern.

The existence of displays in the art does not automatically make it obvious to provide a display, much less to display interference fringes, as claimed in claim 11. Maeda uses a signal from a photo-diode to detect an interference fringe. There is no requirement, nor suggestion of desirability of a display to determine or analyze the signal. In contrast, in claim 11, an out-of-focus condition is determined by measuring the offset of one interference pattern relative to the other, and the offset is readily analyzed when displayed.

The Examiner also relies upon the knowledge of a person of ordinary skill in the art at the time the invention was made to combine a display to show the first and second images with Maeda's apparatus. A statement that the modifications to the prior art are within the ordinary skill of the art is not sufficient to establish a *prima facie* case of obviousness. *See*, *Al-Site Corp.*

v. VSI Int'l Inc., 174 F.3d 1308, 50 USPQ2d 1161 (Fed. Cir. 1999) (The level of skill in the art cannot be relied upon to provide the suggestion to combine references.)

Because neither the prior art nor the ordinarily skilled artisan provides the motivation to display two interference patterns, Appellant submits that claim 11 is patentable for at least this additional reason.

Issue 3: Does the prior art teach or reasonably suggest a processor for receiving data representative of at least two images of interference patterns and for generating output signals indicative of the position of the article relative to the focal plane as recited in claims 12 -14?

Claims 12-14 recite a processor coupled to the output of the detector for receiving data representative of at least two interference patterns and for providing an output signal for adjusting the relative position of the article relative to the focal plane of the optical system. The Examiner cites the operation circuit 100 shown in Maeda Fig. 2 as allegedly anticipating the claimed processor. However, Maeda's operation circuit does not receive data of at least two **interference patterns**, but instead receives data regarding interference fringes. *See*, col. 14, lines 61-65. ("The second diffraction light beams B2 are interfered so that **interference fringes** are generated. The interference fringes are formed on a two-divided photo-detector 109.") (*Emphasis added.*) Maeda's operation circuit detects interference fringes (or their absence), not an interference pattern for comparison to at least an additional interference pattern.

For at least this additional reason, Appellant submits that claims 12-14 are patentable.

IX. CONCLUSION

Pursuant to the foregoing arguments, Appellant submits that claims 1-19 in the subject application are patentable. Accordingly, Appellant respectfully requests that the Examiner's rejections be reversed, and the application allowed at the earliest opportunity.

The present Brief on Appeal is being filed in triplicate. Appellant hereby petitions for any extension of time which may be required to maintain the pendency of this case, and any required fee for such extension is to be charged to Deposit Account No. 19-4880.

Respectfully submitted,

Frank L. Bernstein

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Reg. No. 31,484

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Signed: Thea K. Wagner
Thea K. Wagner

APPENDIX

CLAIMS 1-19 ON APPEAL:

1. An optical apparatus for determining a position of an article, the apparatus comprising an illumination unit, focusing optics and a focus detection unit, wherein:

the illumination unit is operable to generate incident light and illuminate an elongated region of the article for producing light returned from the illuminated region;

the focusing optics directs the incident light towards the article and directs at least a portion of the returned light toward the focus detection unit; and

the focus detection unit comprises an optical system and a detector, the optical system being operable to collect the directed portion of the returned light and create at least two images on a sensing surface of the detector in the form of at least two interference patterns, respectively,

wherein at least one pattern is created by interference between:

light components of the collected light that propagated within a first periphery region of an optical axis of the focusing optics; and

light components of the collected light that propagated within a paraxial region of said optical axis, and

wherein at least one other interference pattern is created by interference between:

light components of the collected light that propagated within a second periphery region of said optical axis, substantially symmetrical to said first periphery region with respect to said optical axis; and

light components of the collected light that propagated within the paraxial region of said optical axis; and

wherein data representative of a relation between intensity profiles in the at least two interference patterns is indicative of the position of the article relative to a focal plane of said focusing optics.

2. The apparatus according to Claim 1, wherein said at least two images are spaced from each other along an X-axis parallel to the illuminated elongated region, such that each two corresponding dark fringes in the two interference patterns and each two corresponding light fringes in the patterns are aligned in two lines, respectively, when in the desired in-focus position of the illuminated region, and, when in two positions of the illuminated region at opposite sides of the focal plane, the at least two images are differently spaced from each other along the X-axis and along a Y-axis, perpendicular to the elongated region, in accordance with a phase difference between the collected light components propagating within the paraxial region and the collected light components propagating within the periphery regions.

3. The apparatus according to Claim 1, wherein said optical system comprises a blocking plate, which is located in an X-Y plane perpendicular to an optical axis of the optical system, and is formed with at least three parallel transmitting slits sufficiently thin to provide diffraction of

light emerging therethrough for picking up at least three light components of the collected light, respectively, which form said at least two interference patterns, the slits extending along the X-axis parallel to the elongated region, and being aligned in a spaced-apart parallel relationship along the Y-axis, such that the optical axis of the optical system intersects with an axis of a central slit, and at least two side slits are centrally symmetrical relative to an intersection point of said optical axis of the optical system and the X-Y plane and are spaced from each other along the X- and Y- axes.

4. The apparatus according to Claim 3, wherein the blocking plate is formed with at least two additional spaced-apart parallel side slits extending along the X-axis, the at least four side slits forming two pairs of side slits located at opposite sides of the central slit, respectively.

5. The apparatus according to Claim 4, wherein each two side slits located at one side of the central slit are spaced-apart from each other and from the central slit along the Y-axis.

6. The apparatus according to Claim 5, wherein each two side slits located at one side of the central slit are spaced-apart from each other along the X-axis.

7. The apparatus according to Claim 6, wherein the optical system forms four interference patterns.

8. The apparatus according to Claim 3, wherein the X-Y plane in which the slits are located is conjugate to a plane of an aperture stop defined by the focusing optics.

9. The apparatus according to Claim 3, wherein said optical system further comprises:

- a first lens assembly accommodated upstream of the blocking plate and collecting said at least portion of the returned light, the first lens assembly being capable of forming an image of an aperture stop defined by the focusing optics in a first plane conjugate to the aperture stop plane along the X-axis, the blocking plate being located in said first conjugate plane;

- a second lens assembly accommodated downstream of the blocking plate, and being capable of forming an image of the illuminated region along the Y-axis in a second plane conjugate to the aperture stop plane along the X-axis; and

- a third lens assembly receiving light emerging from the second assembly and forming images of said at least three slits along the X-axis in the second conjugate plane of the aperture stop.

10. The apparatus according to Claim 9, wherein said sensing surface is located in the second conjugate plane.

11. The apparatus according to Claim 1, further comprising a display coupled to an output of the detector for displaying said first and second images.

12. The apparatus according to Claim 1, further comprising a processor coupled to an output of the detector for receiving data representative of said at least two images and generating output signals indicative of said position of the article relative to the focal plane.

13. The apparatus according to Claim 12, wherein said processor generates a focus error correction signal for providing relative displacement between the article and the focusing optics to maintain the illuminated region within the focal plane.

14. The apparatus according to Claim 1, further comprising a feedback loop, responsive to said output signals, for generating a focus error correction signal and adjusting the relative position of the article relative to the focusing optics to place the illuminated region in the focal plane of the focusing optics.

15. A system for an optical inspection of an article, comprising an optical apparatus for maintaining a desired position of the article, and at least one detection unit, wherein said optical apparatus comprises:

an illumination unit operable to generate incident light and illuminate an elongated region of the article for producing light returned from the illuminated region;

focusing optics that directs the incident light towards the article and directs at least a portion of the returned light towards a focus detection unit;

said focus detection unit comprising an optical system and a detector, the optical system being operable to collect the directed portion of the returned light and create at least two images on a sensing surface of the detector in the form of at least two interference patterns, respectively;

wherein at least one pattern is created by interference between:

light components of the collected light that propagated within a first periphery region of an optical axis of the focusing optics; and

light components of the collected light that propagated within a paraxial region of said optical axis; and

wherein at least one other interference pattern is formed by interference between:

light components of the collected light that propagated within a second periphery region of said optical axis, substantially symmetrical to said first periphery region with respect to said optical axis; and

light components of the collected light that propagated within the paraxial region of said optical axis of the focusing optics; and

wherein data indicative of a relation between intensity profiles in the at least two interference patterns is indicative of the position of the article relative to a focal plane of the focusing optics; and

wherein said at least one detection unit comprises light collecting optics and a detector, the light collecting optics being capable of collecting light returned from the article at elevation angles different from an elevation angle of collection of said at least portion of the returned light defined by said focusing optics.

16. A focus error detection method comprising:

- passing incident light through focusing optics and illuminating an elongated region, thereby producing light returned from the illuminated region;

- collecting at least a portion of the light returned from said illuminated region and passed through said focusing optics;
- picking up at least three spatially separated light components of the collected returned light, so as to cause diffraction of each of said light components and to allow:
    interference between a central light component that propagated within a paraxial region of an optical axis of the focusing optics and at least one first light component that propagated within a first periphery region of said optical axis of the focusing optics; and
    interference between said central light component and at least one second light component of the collected returned light that propagated within a second periphery region of said optical axis of the focusing optics substantially symmetrical to said first periphery region with respect to said optical axis; and
- creating at least two images in the form of at least two interference patterns, respectively, on a sensing surface of a detector, said at least two interference patterns being created by the interference of the separated light components, a relation between intensity profiles in the interference patterns being indicative of the position of the illuminated region relative to a focal plane of said focusing optics.

17. The method according to Claim 16, wherein said at least two images are spaced from each other along an X-axis parallel to the illuminated elongated region, such that each two corresponding dark fringes in the two interference patterns and each two corresponding light fringes in the patterns are aligned in two lines, respectively, when in the desired in-focus position of the illuminated region, and, when in two positions of the illuminated region at opposite sides of the focal plane, the images are differently spaced from each other along the X-axis and along a Y-axis perpendicular to the illuminated region in accordance with phase difference between the light components propagating within the paraxial region and the light components propagating within the periphery regions.

18. A method of maintaining a desired position of an article during processing of the article, the method comprising:

(a) generating an incident beam and illuminating an elongated region of the article to produce light returned from the illuminated region;

(b) directing the incident light toward the article through focusing optics, and collecting with focusing optics at least a portion of the returned light and directing it towards a focus detection unit, said focusing optics defining an aperture stop of light collection;

(c) creating from the collected returned light at least two images of the illuminated region in the form of at least two interference patterns, respectively, said at least two interference patterns being formed by:

interference between a central light component of the collected light that propagated within a paraxial region of an optical axis of the focusing optics and at least one first light component of the collected light that propagated within a first periphery region of the optical axis of the focusing optics, and

interference between said central light component and at least one second light component of the collected light that propagated within a second periphery region of the optical axis of the focusing optics substantially symmetrical to said first periphery region with respect to said optical axis;

(d) detecting light indicative of said at least two images; and

(e) based on said detecting, determining a relation between intensity profiles in the at least two interference patterns, and determining a relative position of the article with respect to a focal plane of the focusing optics, thereby enabling maintenance of the desired position of the article.

19. The method according to Claim 18, wherein the formation of said at least two interference patterns comprises directing the collected returned light along an optical axis of light propagation and passing the collected returned light through at least three transmitting slits, which are sufficiently thin to provide diffraction of light emerging therethrough and are made in a blocking plate located in an X-Y plane, which is perpendicular to said optical axis of light propagation and is conjugate to a plane of the aperture stop, the slits being aligned in a spaced-apart parallel relationship along the Y-axis, such that said optical axis of light propagation

intersects with an axis of a central slit, and at least two side slits are centrally symmetrical relative to an intersection point of said optical axis of light propagation and the X-Y plane where the slits are located, and are spaced from each other along the X- and Y- axes.

Atty. Docket No. 004070 USA/PDC/WF/OR
PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of

Haim FELDMAN

Application No.: 09/855,253 | Group Art Unit: 2878

Confirmation No.: 8980 | Examiner: Tranh X. Luu

Filed: May 15, 2001

For: DYNAMIC AUTOMATIC FOCUSING METHOD AND APPARATUS USING INTERFERENCE PATTERNS (As Amended)

APPELLANT'S BRIEF ON APPEAL UNDER 37 C.F.R. § 1.192

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Appellant, within a two (2) month period from the September 8, 2003, filing date of the Notice of Appeal (November 8 having fallen on a Saturday, and November 10 being the first business day thereafter), herein files an Appeal Brief drafted in accordance with the provisions of 37 C.F.R. § 1.192, as follows:

I. REAL PARTY IN INTEREST

The real party in interest is the owner of the application, APPLIED MATERIALS, INC.

II. RELATED APPEALS AND INTERFERENCES

Appellant is not aware of any other appeals or interferences involving the present application.

III. STATUS OF CLAIMS

Claims 1-19 are all the claims pending in the application. Claims 1, 12-16, and 18 are rejected under 35 U.S.C. § 102(b) as being anticipated by Maeda et al., USP 5,572,323 ("Maeda"). Claim 11 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Maeda. Claims 2-10, 17, and 19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all the limitations of the base claim and any intervening claims.

IV. STATUS OF AMENDMENTS

The claims have not been amended pursuant to final rejection.

V. SUMMARY OF THE INVENTION

As described in the present application, the present invention relates to detection of a position of a plane defined by an article being processed, relative to the focal plane of an optical system, thereby enabling maintenance of accurate focusing of an incident beam from the optical system to the article. According to the present invention, at least two interference patterns formed by light components returned from an elongated illuminated region on the article and passing through at least two symmetrical peripheral regions of the optical axis of a focusing/collecting lens arrangement are detected.

As claimed in the present application, each of these interference patterns is created by interference between collected light formed of light components propagating within one of the periphery regions and collected light formed of light components propagating within the paraxial

regions of the optical axis. The relation between the interference patterns is indicative of the phase difference between the collected light formed of light components propagating within the paraxial and periphery regions, and consequently, of the out-of-focus position of the illuminated region.

Light waves returned from an in-focus plane and passed through a focusing lens will have a substantially flat wavefront. Light waves returned from an out-of-focus plane and passed through a focusing lens will have a substantially spherical wavefronts. As a result, information indicative of distortions produced at any out-of-focus location is actually contained in light propagating within a periphery region of the optical axis, rather than that associated with a paraxial area.

Therefore, it is desirable to analyze light components propagating within the periphery regions, in order to detect a focus error. It is necessary to take into account that light components propagating within the paraxial and periphery regions of the optical axis have different optical paths, respectively, and therefore have a certain phase difference indicative of the out-of-focus position of the article.

As described beginning at page 12 of the application, Fig. 1 shows an optical inspection system 1 which includes a scanning apparatus 1a. As shown in more detail in Fig. 2, and as described beginning at page 15 of the application, the scanning apparatus 1a includes a focus detection unit 8 which includes in turn an optical system 9. The optical system 9 forms images indicative of the position of the surface 2a (Fig. 1) of an article 2 being inspected, relative to the focal plane P on sensing surface 21.

The optical system 9 comprises lens arrangements 30, 32 and 34 and a blocking plate 35 interposed between the lens arrangements 30 and 32. The lens arrangements define a common optical axis OA_2 of light propagation through the optical system 9. The plate 35 is oriented perpendicularly to the optical axis OA_2, i.e., in the X-Y plane.

In the embodiment shown in Fig. 2, the plate 35 is formed with slits 35a, 35b and 35c aligned in a spaced-apart parallel relationship along the Y-axis, the slits 35a and 35b also being spaced with respect to each other along the X-axis. The three slits represent three transmitting regions, respectively, surrounded by blocking regions of the plate 35, thereby picking up three light components from light impinging onto the plate 35 and transmitting them towards the lens arrangement 32. The central slit 35b may extend substantially across the entire plate 35. In the described embodiment, the upper and lower slits 35a and 35c are located centrally symmetrically relative to an intersection point IP_1 between the plate 35 and the optical axis OA_2.

The slits are arranged to transmit light from three transmitting regions from the paraxial and periphery regions of the optical axis. The central slit may extend substantially across the blocking plate, and the other two slits are located centrally symmetrically relative to the central slit.

The slit arrangement described in the present application produces two separate interference patterns. A first interference pattern is produced between one of the two slits and a corresponding half of the central slit. A second interference pattern is produced between the other of the two slits and the corresponding half of the central slit. The interference patterns produced by the three slits are shown in Figs. 4, 5a, and 6a, illustrating in-focus and out-of-focus conditions.

Figs. 3a and 3b in the present application, described beginning at the bottom of page 17 of the specification, illustrate principles of light propagation from in-focus and out-of-focus positions, underlying the above design of the optical system 9. Fig. 3a illustrates a wave front W_1 of returned light 28 (Figs. 1 and 2) corresponding to an in-focus location of an illuminated line S in Fig. 1. As noted earlier, because wave front W_1 corresponds to an in-focus condition, that wave front typically will be substantially flat.

Fig. 3b illustrates a wave front W_2 of the returned light 28 corresponding to an out-of-focus location of the illuminated line S. As also noted earlier, the out-of-focus location is characterized by a substantially spherical wave front W_2. The returned light 28 propagates within regions R_1 and R_2 in Fig. 3b, lying substantially far from and close to the optical axis OA_1, respectively, i.e., periphery and paraxial regions, respectively, with respect to the optical axis OA_1. Significant curvatures of the wave front W_2 are located within the periphery regions R_1; on the other hand, such curvatures are relatively negligible within the paraxial regions R_2.

The periphery regions of the lens are more sensitive to an out-of-focus position of the light source. As a result, detected light formed by light components propagating within the periphery regions R_1 will contain the main information indicative of the out-of-focus location of the line S.

Thus, as described in the Abstract, the first interference pattern is created by interference of light components of the collected light that propagated within a first periphery region of an optical axis of the focusing optics and light components of the collected light that propagated within a paraxial region of the optical axis. The second interference pattern is created by interference

between light components of the collected light that propagated with a second periphery region of the optical axis, symmetrical to the first periphery region with respect to the optical axis, and light components of the collected light that propagated within the paraxial region.

From the foregoing description, and the discussion of periphery and paraxial regions of the optical axis as discussed in the present application, the interference patterns that the invention produces are separate and distinct, and not merely two halves of the same interference pattern. This distinction is critical to an understanding of the differences between the claimed invention and Maeda, as now will be discussed.

VI. ISSUES

1. Does the prior art teach or reasonably suggest a focus error correction method and apparatus wherein at least two interference patterns are created, a first interference pattern created by interference between light components of a first periphery region and a paraxial region of an optical axis, and a second interference pattern created by interference between light components of a second periphery region and the paraxial region of the optical axis a as recited in claims 1, 15-16, and 18?

2. Does the prior art teach or reasonably suggest a focus error correction method and apparatus having a display for displaying the first and second images, as recited in claim 11?

3. Does the prior art teach or reasonably suggest a processor for receiving data representative of at least two images of interference patterns and for generating output

signals indicative of the position of the article relative to the focal plane as recited in claims 12-14?

VII. GROUPING OF CLAIMS

Claims 1, 15-16, and 18 stand and fall together. Claim 11 stands or falls on its own. Claims 12 -14 stand and fall together.

VIII. ARGUMENTS

Issue 1: **Does the prior art teach or reasonably suggest a focus error correction method and apparatus wherein at least two interference patterns are created, a first interference pattern created by interference between light components of a first periphery region and a paraxial region of an optical axis, and a second interference pattern created by interference between light components of a second periphery and the paraxial region of the optical axis a as recited in claims 1, 15, 16, and 18?**

Claims 1, 15-16, and 18 recite creating at least two interference patterns, wherein a first interference pattern is created by interference between light collected from within a first periphery region and from within a paraxial region of an optical axis, and wherein a second interference pattern is created by interference between light collected from within a second periphery region and from within a paraxial region of the optical axis. The claims further recite the structures required to provide the light necessary to form the at least two interference patterns. Maeda does not anticipate, teach, or suggest an apparatus or method for providing at least two interference patterns between at least two periphery regions of an optical axis and a paraxial region of the optical axis. To the contrary, Maeda describes a focusing apparatus that relies upon a single interference pattern generated by a first and a second diffraction grating.

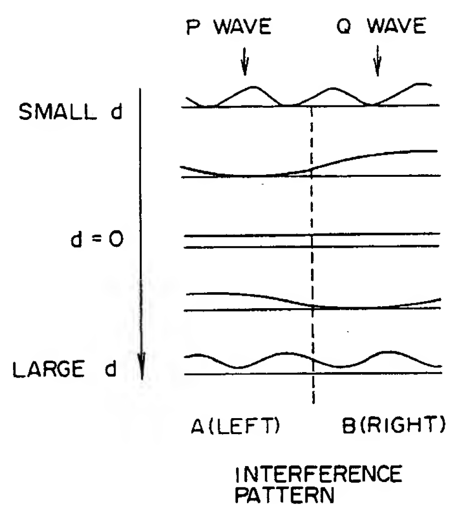
Also, Maeda does not anticipate, teach, or suggest forming interference patterns from different regions of a beam of light.

Maeda takes two peripheral rays and subjects them each to double diffraction gratings, thus producing multiple diffraction orders because of each of the rays. One diffraction order from one of the initial rays is interfered with the inverse diffraction order from the other ray. The resulting interference produces a <u>single</u> set of fringes, with a pitch corresponding to the amount of the out-of-focus condition. The measurement then depends on measuring the pitch of the final interference pattern, which is a single pattern. There is no use of a central ray as described and claimed in the present application.

In contrast, according to the present invention, two peripheral rays each are interfered with a central ray, thus producing two interference patterns (two sets of fringes, not just one, as in Maeda). The fringes are of fixed pitch, not variable as in Maeda (where the variability corresponds to the defocus condition). Rather, in the invention, the degree of defocus depends on the relative offset between the multiple fringes. Thus, to determine the degree of defocus in the invention, it is necessary to measure the amount of that offset. This is the claimed relation between intensity profiles in the at least two interference patterns, that relation being indicative of the position of the article relative to a focal plane of the focusing optics. This language is found in all of the independent claims, and clearly distinguishes over Maeda.

The Examiner directs Appellant's attention to Maeda, Figs. 11a-b-c and 12 wherein Fig. 12 purportedly shows two interference patterns, one on the left of the figure and the other on the right of the figure. Maeda Fig. 12 is reproduced below:

FIG. 12



Maeda describes Fig. 12 by stating, "Qualitatively, light intensity distribution of **the interference pattern** is varied in accordance with the states of the defocusing, as shown in FIG. 12. In FIG. 12, the light intensity distributions of **the interference pattern** in cases where the defocusing d is negative (d) and positive (d) are inverted to each other." *See*, col. 10, lines 29-33 (*emphasis added*). Maeda itself refers to Fig. 12 as showing only a single interference pattern. The dashed line merely differentiates between the P and Q waveforms in that single interference pattern.

By Maeda's own description, Fig. 12 does not show, nor did Maeda intend to show, more than a single interference pattern. The Examiner' inference of multiple interference patterns

from Maeda is a distortion of the fair teaching of Maeda, and represents the sheerest form of hindsight reconstruction.

The P and Q waves shown in Maeda Figs. 11 a-b-c are plus or minus first order diffraction lights used to measure the defocusing of the illuminating laser beam. The P and Q waves are formed by two diffraction gratings each having the same period, but the phase difference between the first and the second grating is one-quarter wave length. The P and Q waves propagate parallel to each other in an interleaved pattern, and when defocusing occurs, each of the P and Q waves are microscopically deformed such that the normally parallel wave fronts intersect thereby causing an interference pattern as shown in Fig. 2. *See*, col. 10, lines 1-28.

An interference pattern is formed when two waves intersect. Maeda describes forming two waves, the P and Q waves, using two diffraction gratings. The intersection of these waves contains information regarding the focusing condition. The two intersecting waves can form only a single interference pattern. Therefore, Maeda can only be describing a single interference pattern. In contrast, the present application claims <u>at least two interference patterns</u>.

Not only is the Examiner's interpretation of Maeda inconsistent with Maeda's fair teaching; Appellant's interpretation of Fig. 12 is consistent with Maeda's specification and claims. Throughout the specification and claims, Maeda refers only to a single interference pattern as indicated by the use of the article "the" to modify "interference pattern." Nowhere in the specification or claims does Maeda refer to more than one interference pattern, directly or indirectly. In the brief description of the drawings, at col. 4, lines 20-21, Maeda says that Fig. 12

"is a diagram illustrating the light intensity distribution of interference patterns". This passage does not state that Maeda teaches multiple interference patterns. Indeed, as can be seen from the quotes from Maeda actually describing Fig. 12, there is but a single interference pattern intended and described. As discussed above, Fig. 12 shows an interference pattern in various conditions of defocus, and Maeda is referring to the light intensity distribution of the different states of defocus.

The Examiner has stated that an interference pattern "divided in half produces two interference patterns." *See* OAS dated 5/7/2003, p. 5, para. 8. Appellant contends that dividing a single interference pattern yields only copies of the single interference pattern. Dividing a single interference pattern does not produce multiple interference patterns, as described and claimed in the present application.

As Appellant argued above, an interference pattern is generated by the intersection of two light waves. The present application describes at least two such intersections: light from a first periphery region and from the paraxial region; and light from a second periphery region and the paraxial region. These two intersections form two distinct interference patterns, not two copies of a single interference pattern. Therefore, even if Maeda's Fig. 12 were to show a divided interference pattern – which Appellant contends it does not – that Figure cannot anticipate or render obvious the claimed two interference patterns.

Additionally, claims 1, 15-16, and 18 recite that interference patterns are formed from at least two periphery regions of an optical axis and a paraxial region of the optical axis. In contrast, Maeda provides a single interference pattern of the entire reflected beam as shown in

Fig. 2. "A reflected laser beam from the article 13 travels through the objective lens 12 again and passes through the beam splitter 11. The laser beam from the beam splitter 11 is incident on a double grating unit 14 having a function for generating interference fringes." *See*, col. 5, lines 1-5. Maeda does not teach or suggest that the single interference pattern is formed by the intersection of light from one region of the reflected beam with the light from another region, but instead, the entire reflected beam impinges upon the diffraction gratings to form the single interference pattern.

Therefore, Appellant contends that there is no motivation in the prior art to provide the configurations set forth in claims 1, 15-16, and 18. Appellant submits that these claims are patentable.

Issue 2: Does the prior art teach or reasonably suggest a focus error correction method and apparatus having a display for displaying the first and second images, as recited in claim 11?

In rejecting claim 11 in view of Maeda, the Examiner took the position that it would have been obvious to a person of ordinary skill in the art to provide a display for displaying the claimed images, even though Maeda discloses no such display. Looking more closely at claim 11, the claim recites a display for monitoring the first and second interference pattern images.

In addition to there being no teaching or suggestion in Maeda that more than one interference pattern is generated, there is no teaching or suggestion that such interference patterns should be displayed. In Figs. 17A-B, Maeda shows an infinitesimal displacement system that relies upon the detection of individual fringes of the interference pattern to provide control signals for adjusting the focus. Interference fringes are present when the system is not in

focus. Maeda uses photo-detectors having two detection areas to detect an out-of-focus condition by the presence or absence of fringes, and to provide a driving signal to move the objective lens. *See*, col. 16 line 50 to col. 17, line 16. There is nothing about displaying interference pattern images.

Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the references themselves or in the knowledge generally available to one of ordinary skill in the art. *See* MPEP 2143.01. Maeda provides no motivation to combine a display for monitoring interference patterns with the teachings of Maeda because Maeda's detecting circuitry detects the presence or absence of fringes only. There is no motivation to view the entire interference pattern.

The existence of displays in the art does not automatically make it obvious to provide a display, much less to display interference fringes, as claimed in claim 11. Maeda uses a signal from a photo-diode to detect an interference fringe. There is no requirement, nor suggestion of desirability of a display to determine or analyze the signal. In contrast, in claim 11, an out-of-focus condition is determined by measuring the offset of one interference pattern relative to the other, and the offset is readily analyzed when displayed.

The Examiner also relies upon the knowledge of a person of ordinary skill in the art at the time the invention was made to combine a display to show the first and second images with Maeda's apparatus. A statement that the modifications to the prior art are within the ordinary skill of the art is not sufficient to establish a *prima facie* case of obviousness. *See, Al-Site Corp.*

v. VSI Int'l Inc., 174 F.3d 1308, 50 USPQ2d 1161 (Fed. Cir. 1999) (The level of skill in the art cannot be relied upon to provide the suggestion to combine references.)

Because neither the prior art nor the ordinarily skilled artisan provides the motivation to display two interference patterns, Appellant submits that claim 11 is patentable for at least this additional reason.

Issue 3: Does the prior art teach or reasonably suggest a processor for receiving data representative of at least two images of interference patterns and for generating output signals indicative of the position of the article relative to the focal plane as recited in claims 12 -14?

Claims 12-14 recite a processor coupled to the output of the detector for receiving data representative of at least two interference patterns and for providing an output signal for adjusting the relative position of the article relative to the focal plane of the optical system. The Examiner cites the operation circuit 100 shown in Maeda Fig. 2 as allegedly anticipating the claimed processor. However, Maeda's operation circuit does not receive data of at least two **interference patterns**, but instead receives data regarding interference fringes. *See*, col. 14, lines 61-65. ("The second diffraction light beams B2 are interfered so that **interference fringes** are generated. The interference fringes are formed on a two-divided photo-detector 109.") (*Emphasis added.*) Maeda's operation circuit detects interference fringes (or their absence), not an interference pattern for comparison to at least an additional interference pattern.

For at least this additional reason, Appellant submits that claims 12-14 are patentable.

IX. CONCLUSION

Pursuant to the foregoing arguments, Appellant submits that claims 1-19 in the subject application are patentable. Accordingly, Appellant respectfully requests that the Examiner's rejections be reversed, and the application allowed at the earliest opportunity.

The present Brief on Appeal is being filed in triplicate. Appellant hereby petitions for any extension of time which may be required to maintain the pendency of this case, and any required fee for such extension is to be charged to Deposit Account No. 19-4880.

Respectfully submitted,

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Alexandria, VA 22313-1450

Date: January 20, 2004

Signed: Thea K. Wagner
Thea K. Wagner

APPENDIX

CLAIMS 1-19 ON APPEAL:

1. An optical apparatus for determining a position of an article, the apparatus comprising an illumination unit, focusing optics and a focus detection unit, wherein:

the illumination unit is operable to generate incident light and illuminate an elongated region of the article for producing light returned from the illuminated region;

the focusing optics directs the incident light towards the article and directs at least a portion of the returned light toward the focus detection unit; and

the focus detection unit comprises an optical system and a detector, the optical system being operable to collect the directed portion of the returned light and create at least two images on a sensing surface of the detector in the form of at least two interference patterns, respectively,

wherein at least one pattern is created by interference between:

light components of the collected light that propagated within a first periphery region of an optical axis of the focusing optics; and

light components of the collected light that propagated within a paraxial region of said optical axis, and

wherein at least one other interference pattern is created by interference between:

light components of the collected light that propagated within a second periphery region of said optical axis, substantially symmetrical to said first periphery region with respect to said optical axis; and

light components of the collected light that propagated within the paraxial region of said optical axis; and

wherein data representative of a relation between intensity profiles in the at least two interference patterns is indicative of the position of the article relative to a focal plane of said focusing optics.

2. The apparatus according to Claim 1, wherein said at least two images are spaced from each other along an X-axis parallel to the illuminated elongated region, such that each two corresponding dark fringes in the two interference patterns and each two corresponding light fringes in the patterns are aligned in two lines, respectively, when in the desired in-focus position of the illuminated region, and, when in two positions of the illuminated region at opposite sides of the focal plane, the at least two images are differently spaced from each other along the X-axis and along a Y-axis, perpendicular to the elongated region, in accordance with a phase difference between the collected light components propagating within the paraxial region and the collected light components propagating within the periphery regions.

3. The apparatus according to Claim 1, wherein said optical system comprises a blocking plate, which is located in an X-Y plane perpendicular to an optical axis of the optical system, and is formed with at least three parallel transmitting slits sufficiently thin to provide diffraction of

light emerging therethrough for picking up at least three light components of the collected light, respectively, which form said at least two interference patterns, the slits extending along the X-axis parallel to the elongated region, and being aligned in a spaced-apart parallel relationship along the Y-axis, such that the optical axis of the optical system intersects with an axis of a central slit, and at least two side slits are centrally symmetrical relative to an intersection point of said optical axis of the optical system and the X-Y plane and are spaced from each other along the X- and Y- axes.

4. The apparatus according to Claim 3, wherein the blocking plate is formed with at least two additional spaced-apart parallel side slits extending along the X-axis, the at least four side slits forming two pairs of side slits located at opposite sides of the central slit, respectively.

5. The apparatus according to Claim 4, wherein each two side slits located at one side of the central slit are spaced-apart from each other and from the central slit along the Y-axis.

6. The apparatus according to Claim 5, wherein each two side slits located at one side of the central slit are spaced-apart from each other along the X-axis.

7. The apparatus according to Claim 6, wherein the optical system forms four interference patterns.

8. The apparatus according to Claim 3, wherein the X-Y plane in which the slits are located is conjugate to a plane of an aperture stop defined by the focusing optics.

9. The apparatus according to Claim 3, wherein said optical system further comprises:

- a first lens assembly accommodated upstream of the blocking plate and collecting said at least portion of the returned light, the first lens assembly being capable of forming an image of an aperture stop defined by the focusing optics in a first plane conjugate to the aperture stop plane along the X-axis, the blocking plate being located in said first conjugate plane;

- a second lens assembly accommodated downstream of the blocking plate, and being capable of forming an image of the illuminated region along the Y-axis in a second plane conjugate to the aperture stop plane along the X-axis; and

- a third lens assembly receiving light emerging from the second assembly and forming images of said at least three slits along the X-axis in the second conjugate plane of the aperture stop.

10. The apparatus according to Claim 9, wherein said sensing surface is located in the second conjugate plane.

11. The apparatus according to Claim 1, further comprising a display coupled to an output of the detector for displaying said first and second images.

12. The apparatus according to Claim 1, further comprising a processor coupled to an output of the detector for receiving data representative of said at least two images and generating output signals indicative of said position of the article relative to the focal plane.

13. The apparatus according to Claim 12, wherein said processor generates a focus error correction signal for providing relative displacement between the article and the focusing optics to maintain the illuminated region within the focal plane.

14. The apparatus according to Claim 1, further comprising a feedback loop, responsive to said output signals, for generating a focus error correction signal and adjusting the relative position of the article relative to the focusing optics to place the illuminated region in the focal plane of the focusing optics.

15. A system for an optical inspection of an article, comprising an optical apparatus for maintaining a desired position of the article, and at least one detection unit, wherein said optical apparatus comprises:

an illumination unit operable to generate incident light and illuminate an elongated region of the article for producing light returned from the illuminated region;

focusing optics that directs the incident light towards the article and directs at least a portion of the returned light towards a focus detection unit;

said focus detection unit comprising an optical system and a detector, the optical system being operable to collect the directed portion of the returned light and create at least two images on a sensing surface of the detector in the form of at least two interference patterns, respectively;

wherein at least one pattern is created by interference between:

light components of the collected light that propagated within a first periphery region of an optical axis of the focusing optics; and

light components of the collected light that propagated within a paraxial region of said optical axis; and

wherein at least one other interference pattern is formed by interference between:

light components of the collected light that propagated within a second periphery region of said optical axis, substantially symmetrical to said first periphery region with respect to said optical axis; and

light components of the collected light that propagated within the paraxial region of said optical axis of the focusing optics; and

wherein data indicative of a relation between intensity profiles in the at least two interference patterns is indicative of the position of the article relative to a focal plane of the focusing optics; and

wherein said at least one detection unit comprises light collecting optics and a detector, the light collecting optics being capable of collecting light returned from the article at elevation angles different from an elevation angle of collection of said at least portion of the returned light defined by said focusing optics.

16. A focus error detection method comprising:

- passing incident light through focusing optics and illuminating an elongated region, thereby producing light returned from the illuminated region;

- collecting at least a portion of the light returned from said illuminated region and passed through said focusing optics;
- picking up at least three spatially separated light components of the collected returned light, so as to cause diffraction of each of said light components and to allow:

  interference between a central light component that propagated within a paraxial region of an optical axis of the focusing optics and at least one first light component that propagated within a first periphery region of said optical axis of the focusing optics; and

  interference between said central light component and at least one second light component of the collected returned light that propagated within a second periphery region of said optical axis of the focusing optics substantially symmetrical to said first periphery region with respect to said optical axis; and
- creating at least two images in the form of at least two interference patterns, respectively, on a sensing surface of a detector, said at least two interference patterns being created by the interference of the separated light components, a relation between intensity profiles in the interference patterns being indicative of the position of the illuminated region relative to a focal plane of said focusing optics.

17. The method according to Claim 16, wherein said at least two images are spaced from each other along an X-axis parallel to the illuminated elongated region, such that each two corresponding dark fringes in the two interference patterns and each two corresponding light fringes in the patterns are aligned in two lines, respectively, when in the desired in-focus position of the illuminated region, and, when in two positions of the illuminated region at opposite sides of the focal plane, the images are differently spaced from each other along the X-axis and along a Y-axis perpendicular to the illuminated region in accordance with phase difference between the light components propagating within the paraxial region and the light components propagating within the periphery regions.

18. A method of maintaining a desired position of an article during processing of the article, the method comprising:

(a) generating an incident beam and illuminating an elongated region of the article to produce light returned from the illuminated region;

(b) directing the incident light toward the article through focusing optics, and collecting with focusing optics at least a portion of the returned light and directing it towards a focus detection unit, said focusing optics defining an aperture stop of light collection;

(c) creating from the collected returned light at least two images of the illuminated region in the form of at least two interference patterns, respectively, said at least two interference patterns being formed by:

interference between a central light component of the collected light that propagated within a paraxial region of an optical axis of the focusing optics and at least one first light component of the collected light that propagated within a first periphery region of the optical axis of the focusing optics, and

interference between said central light component and at least one second light component of the collected light that propagated within a second periphery region of the optical axis of the focusing optics substantially symmetrical to said first periphery region with respect to said optical axis;

(d) detecting light indicative of said at least two images; and

(e) based on said detecting, determining a relation between intensity profiles in the at least two interference patterns, and determining a relative position of the article with respect to a focal plane of the focusing optics, thereby enabling maintenance of the desired position of the article.

19. The method according to Claim 18, wherein the formation of said at least two interference patterns comprises directing the collected returned light along an optical axis of light propagation and passing the collected returned light through at least three transmitting slits, which are sufficiently thin to provide diffraction of light emerging therethrough and are made in a blocking plate located in an X-Y plane, which is perpendicular to said optical axis of light propagation and is conjugate to a plane of the aperture stop, the slits being aligned in a spaced-apart parallel relationship along the Y-axis, such that said optical axis of light propagation

intersects with an axis of a central slit, and at least two side slits are centrally symmetrical relative to an intersection point of said optical axis of light propagation and the X-Y plane where the slits are located, and are spaced from each other along the X- and Y- axes.